

panel headed by Dr. Richard Bolt, who is, himself, the head of Bolt, Beranek, and Newman.

It would be appropriate at this time, Mr. Chairman, to recall Dr. Barger.

Chairman STOKES. The committee recalls Dr. Barger.

FURTHER TESTIMONY OF DR. JAMES BARGER

Chairman STOKES. Doctor, you have previously been sworn in these hearings, and I would at this time admonish you that you are still under that oath. You understand that, of course.

Dr. BARGER. Yes, I do.

Chairman STOKES. Thank you. The Chair recognizes counsel for the committee, Mr. Jim Wolf.

Mr. WOLF. Welcome back, Dr. Barger. You last testified in great detail before this committee in public session on September 11, 1978. Today, I would like to review briefly some of the points you made during that testimony and then ask you to comment upon the testimony that we heard this morning from Professors Weiss and Aschkenasy. Prior to that, however, in reference to the work that you did on the Kent State tapes that Professor Blakey made reference to in his narration, is it correct that in your work on that tape recording you determined both the location of the shooters and the timing of the shots from an acoustical analysis and that your determination of both location of the shooters and timing of the shots was subsequently stipulated by the defense to be correct and admitted into evidence in a court case?

Dr. BARGER. That is correct.

Mr. WOLF. When were you first approached by this committee with the Dallas Police dispatch tape?

Dr. BARGER. I believe it was in May of 1978.

Mr. WOLF. Am I correct that after a review of that tape, filtering of the tape, and your performance of a series of tests upon that tape, you eventually recommended to the committee that it conduct a reenactment in Dallas which would entail shooting at target locations while you recorded those sounds on microphones?

Dr. BARGER. Yes, that is correct.

Mr. WOLF. When was that reenactment conducted for the committee?

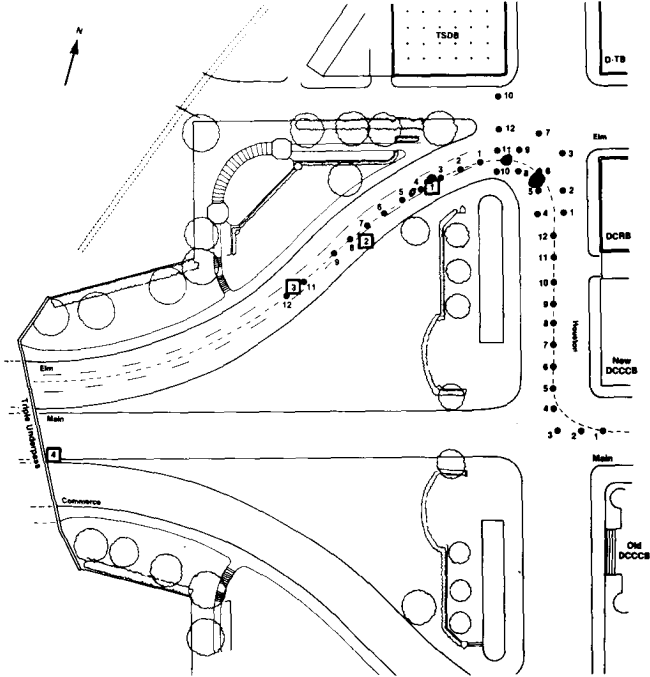
Dr. BARGER. August 20.

Mr. WOLF. I would ask, Mr. Chairman, that JFK exhibit F-337 be displayed and inserted into the record at this time.

Chairman STOKES. Without objection, it may be entered into the record at this point.

[The information follows:]

Microphone Locations at Dealey Plaza



JFK EXHIBIT F-337

Mr. WOLF. This exhibit is a diagram of Dealey Plaza and the microphone locations that were used during the reenactment test. Dr. Barger, I will ask you to briefly explain what the No.'s 1, 2, 3, and 4 are on that exhibit.

Dr. BARGER. Numbers 1, 2, 3 and 4, which appear in the box here, represent the location of the sandbag targets that were placed on the street as targets for the gunfire.

Mr. WOLF. What do the numbers 1 through 12 that appear on the street represent? I believe there are three sequences of them.

Dr. BARGER. Yes; there are three sequences 1 through 12. Each of these sequences represents the position of 12 microphones that were placed in those three groups of 12 to receive the sounds of the gunfire that were fired.

Mr. WOLF. During that test firing, what were the two locations used to fire weapons from?

Dr. BARGER. Weapons were fired from the sixth floor, corner window, southeast corner of the Texas School Book Depository and from behind the fence on the knoll at this point.

Mr. WOLF. Were weapons fired from each location at each of the targets?

Dr. BARGER. That is correct. Rifles from the Texas School Book Depository were fired at each of the four targets. A rifle from the knoll was fired at each of the four targets. I am sorry; at targets 2, 3, and 5. We did not fire at target one for safety reasons. In addition, a pistol was fired from the knoll position here at target location No. 3.

Mr. WOLF. During those test firings you recorded through those microphones the sounds of those test firings?

Dr. BARGER. That is correct.

Mr. WOLF. Mr. Chairman, at this point, I would like JFK exhibit F-367 to be displayed and inserted into the record.

Chairman STOKES. Without objection, it may be entered into the record.

[The information follows:]

**List of All 15 Correlations Between Impulse Patterns
Occurring in 6 Segments of the DPD Record and Echo Patterns
from 432 Test Shots (2592 Separate Correlations)
Having a Correlation Coefficient Higher than 0.5**

Beginning Time of First Impulse on Tape Segment	Microphone Array and (Channel Number)	Rifle Location	Target Location	Correlation Coefficient**
136.20 sec	No Correlations Higher Than			0.5
① [137.70 sec	2 (5)	TSBD*	1	0.6
"	2 (5)	TSBD*	3	0.7
"	2 (6)	TSBD	3	0.8
"	2 (6)	KNOLL	4	0.7
② [139.27 sec	2 (6)	TSBD*	3	0.8
"	2 (6)	TSBD	3	0.6
"	2 (10)	TSBD	3	0.6
140.32 sec	2 (11)	TSBD*	3	0.6
③ [139.27 sec	3 (5)	KNOLL	2	0.6
145.15 sec	3 (4)	KNOLL	3	0.8
"	3 (7)	TSBD*	2	0.7
"	3 (8)	TSBD	3	0.7
④ [145.61 sec	3 (5)	TSBD	3	0.8
"	3 (6)	TSBD	4	0.8
"	3 (8)	TSBD*	2	0.7
146.30 sec	No Correlations Higher Than			0.5

*Indicates Muzzle Withdrawn 2 ft from Plane of Window.

$$^{**}\text{Correlation Coefficient} = \frac{\text{Number of Echoes Matched with Impulses}}{\sqrt{\text{Number of Echoes X Number of Impulses}}} \leq 1.0$$

JFK EXHIBIT F-367

Mr. WOLF. Does this exhibit represent those recordings made during the reenactment which matched the original Dallas Police dispatch tape with a correlation coefficient of at least .5?

Dr. BARGER. Yes, they do. I wish at this time I could say a few words about the stark simplicity of the matching procedure that was used.

Mr. WOLF. Surely.

Dr. BARGER. If I may briefly, to clarify this exhibit, since it came after three hours of explanation the last time, there were obtained at each of these microphones the series of echoes that were received by them when each of these rifles was fired, and it was suggested the last time that I spoke that these might be likened to fingerprints. That is not just a bad idea.

There is a pattern of sounds that emanate from each microphone when each rifle is fired that is unique and that pattern is as much a fingerprint that identifies two things uniquely, the location of the rifle and the location of the receiver. Now obtained on the Dallas Police recording that we discussed this morning were the sounds of impulses, segments of impulses that look like fingerprints, too.

They were badly smudged by the presence of noise. We sought to match the fingerprints we measured in the reconstruction with the fingerprints that had been recorded, perhaps by Officer McLain in 1963. We did that matching. We did it in a numerical way. The numerical procedure allowed us to score each match.

Now we had 432 different combinations of rifle shots and microphones, so we had 432 fingerprints, as from 432 individuals, and we wished to see if any one of those individuals were on the tape recording as recorded by Officer McLain, perhaps. So we matched each of the 432 fingerprints with each of the microphones, that is, with each of six patterns of impulses that were on the Dallas tape to see if any of them matched at all. We had a scoring procedure. Every time the match was so good that the score was higher than .5, we said that is a very likely match. That individual may exist at that place on the tape. Now, I can explain what this is.

Mr. WOLF. When was that matching process completed?

Dr. BARGER. It turned out there were 2,592 matches to achieve, and each one was somewhat difficult because of the smudging of the fingerprints, and since the fingerprints were only obtained on the 20th of August, it was not until the 6th of September that each of the 2,592 comparisons had been made.

Now, that was 4 days before the hearing, given that it takes 1 day to prepare for 1 day's testimony; we had 3 days to wrestle with the fact that there were, in fact, four possible matches of fingerprints identified in the Dallas tape. And at the time that I spoke on the 20th of August, I indicated that of the six segments on the Dallas police recording that contained any impulse patterns at all, in other words, potential fingerprints, the first one began at this time. We found no scores matching with any of these test shots higher than .5. However, a short time later, about a second and a half later, there was a series of sound impulses on the Dallas tape which, in fact, scored above my threshold of .5 to be considered as a potential fingerprint. We found when the rifle was located in the Texas School Book Depository which is here and fired at the target 1, which is here, we passed our threshold, and we got a score, a matching fingerprint score that was higher than .5 for the microphone located in the second array, microphone 5, that one right there.

Mr. WOLF. Dr. Barger, on JFK exhibit F-337, I believe when you testified on September 11, you marked in colored pencil with blue, red, green, and black, the approximate correlations between the location of the microphone that picked up the impulse and the location of the motorcycle, if it were traveling in the motorcade. Is that correct?

Dr. BARGER. Yes; that is correct.

Mr. WOLF. How precise are your locations for the motorcycle as represented by those blue, green, red, and black dots?

Dr. BARGER. I will try not to belabor this point, but at the time that this experiment was designed, we did not know whether the motorcycle was in Dealey Plaza, and we didn't certainly know where along this entire path it was. So it was necessary to sample for fingerprints, as it were, at every 18-foot interval. The process thus designed turned out to be capable of locating, in fact, shots by the fingerprint method that I have been describing. However, it

could not do it in space any more accurately than the distance between two adjacent microphones. In other words, I could only locate the possible location of that motorcycle at each time the fingerprint was found on the Dallas tape to within 18 feet.

Mr. WOLF. So, for example, it is possible that that blue dot would be on the other side of the location of that microphone?

Dr. BARGER. The blue dot I put to show the approximate location of the motorcycle at the time on the Dallas tape that the first possible match was determined, I placed between microphones 5 and 6. It could equally have been placed between microphones 4 and 5, which would put it there.

Mr. WOLF. Those four groupings that you have are the four impulses on the Dallas Police dispatch tape that you identified during the hearing in September as possibly representative of gunfire in Dealey Plaza; is that correct?

Dr. BARGER. That is correct. I subsequently indicated there were four other times on the Dallas Police tape at which our matching process indicated the possibility of a shot; in other words, a match between the test shots and the impulses on the tape by the fingerprint process. The location of the microphone that was picking up these sounds on the Dallas Police tape, in other words, the location of presumably Officer McLain's motorcycle, could be positioned, then, as being within 18 feet of the microphone that indicated that is where the match occurred, and, of course, since the subsequent shots were fired later on in time, I was able to indicate that the motorcycle was approximately here at the time of the first shot and here at the time of the second, and here at the time of the third, if, in fact, it were to be proved to be a shot, and here at the time of the fourth.

Mr. WOLF. Does your prediction of the locations of the motorcycle correspond to the testimony given by Officer McLain this morning?

Dr. BARGER. Yes. In my judgment it certainly does. The officer was able to remember—I was very pleased to hear—that when he was around the corner from Main onto Houston, he could see the Presidential limousine disappearing around the corner here from Houston onto Elm. That distance would be on the order of 180 feet. So he would then be somewhere around 180 feet, perhaps a little less, from the Presidential limousine at that time. Now, the distance from where we think that he was at the time of the first shot, which is here, to the distance where the Presidential limousine was at the time of the first shot is about somewhere between 120 and 138 feet. Again, there is an 18-foot uncertainty. I just said that we have located with our acoustic analysis the result that the motorcycle was 120 to 138 feet behind the limousine at the time of the first shot, which is right about here. Officer McLain remembers having been about 160 to 180 feet behind at this time. He would have, therefore, had to close a little gap, had to gain a bit on the Presidential limousine as he came down Houston.

Mr. WOLF. That, I assume, should be expected if the limousine was slowing as it went around the turn.

Dr. BARGER. Yes; that would happen in the accordion procedure he described, as the Presidential limousine went around here, he would catch up. One of the first points I made as we were analyzing the tape was that the speed remained high until just before the

first shot was detected, and, of course, he would have to slow at that point to negotiate that corner.

Mr. WOLF. Thank you. You may return to the witness table, Dr. Barger.

At this point, Mr. Chairman, I would ask that we mark as "JFK Exhibit F-680" a report that has been submitted to the committee by Mr. Anthony Pellicano. Mr. Pellicano is an independent investigator who submitted a report to the committee after Dr. Barger's testimony in September. Mr. Pellicano has never worked for the committee or been affiliated with the committee in any capacity.

[JFK exhibit F-680 was marked for identification and follows:]

JFK EXHIBIT F-680



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VOICE IDENTIFICATION
 MAGNETIC TAPE ANALYSIS
 AUDIO TAPE RESTORATION
 EXPERT TESTIMONY

JFK Exhibit F-680

1107

ANALYSIS AND COMMENTSRE: THE DALLAS POLICE TAPES ET AL

RESPECTFULLY SUBMITTED TO THE
 SELECT COMMITTEE ON ASSASSINATIONS
 U.S. HOUSE OF REPRESENTATIVES
 3380 HOUSE OFFICE BUILDING, ANNEX 2
 WASHINGTON, D.C.

G. ROBERT BLAKEY, Chief Counsel and Director

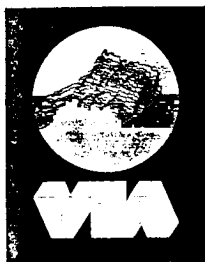
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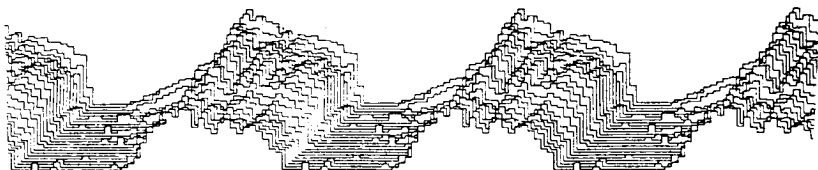
December 13, 1978

Mr. Gary Cornwell, et al
Select Committee on Assassinations
U. S. House of Representatives
3369 House Office Building, Annex 2
Washington, D. C. 20515

RE: ACOUSTICAL STUDY OF DALLAS POLICE TAPES

BACKGROUND

In the course of its investigation into the assassination of President John F. Kennedy, the Select Committee on Assassinations has determined that during a period of approximately five minutes on November 22, 1963 a Dallas, Texas, police motorcycle transmitter, operating on police Channel #1, had its transmitter keyed continuously on; that this five minute period was probably a coincident with the time of the assassination; and that Channel #1 transmissions were continuously recorded on a dictabelt at Dallas police headquarters. The possibility was considered that this motorcycle may have been part of the presidential motorcade and, if so, it may have transmitted the sounds of the shots, thereby allowing a resolution of the conflicting testimony concerning the number of shots which were fired.



It should be noted, however, that the motorcade was operating on Channel #2, which channel was implimented specifically for the motorcade on associated police vehicles. Channel #1 was maintained for normal Dallas police communications traffic. While it would appear unlikely that a vehicle that was a part of the motorcade would be on other than the motorcade channel, the possiblity of an error in channel selection apparently was sufficient to warrant further investigation.

BASIS FOR MY INVESTIGATION

Upon learning by means of the news media of the possibility that the shots were recorded, I was desirous of determining at the earliest possible moment whether there had, in fact, been more than three shots, since I had never been completely satisfied with the Warren Commission Report in this regard. My company, Voice Interpretation & Analysis, Ltd., is equipped with the instrumentation and equipment which would probably have been required for such a determination. The following is a description of the equipment used:

A Hewlett-Packard 9845A Computer interfaced to the following electronic equipment:

An Analogic Computer Data Conversion System (analog to digital converter).

A Nicolet Scientific Corporation 444A Mini-ubiquitous FFT Computing Spectrum Analyzer.

A 9872A Digital Plotter.

(Software for adaptive filtering, FFT, and additional necessary algorithms also programmed.)

Bruel and Kjaer Frequency Spectrum Shaper Type 5587 (analog).

A Rockwell International Automatic Digital Audio Processor (Digital Adaptive Predictive Deconvolver and Adaptive Filter).

A Voice Identification Incorporated Series 700 Analog Frequency Spectrograph.

Along with a laboratory filled with additional supportive electronic, optical scientific testing equipment, and magnetic tape recording equipment, which can be additionally listed if necessary.

PREDICATION

I obtained from Mary Ferrell of Dallas, Texas, a taped copy of the Channel #1 dictabelt (which was formerly in the hands of The Committee and subsequently returned to Mary Ferrell). My initial approach was similar to that being followed by Bolt, Beranek & Newman (BB&N) in their initial test, in that I subjected the tape to various combinations of adapted filtering, analog filtering, and fast fourier transform spectrum analysis to attempt to detect events which could have been shots. This approach was unsuccessful. (This, apparently was unremarkable, since BB&N subsequently reported that they were unable to detect such events from this taped copy, although they report the presence of events which could be shots on another taped copy.)

My second approach was that of studying the taped contents for the purpose of applying deduction analysis. This approach ultimately involved investigation in addition to the analysis of this tape.

ANALYSIS

The first significant finding involved the sound of the motorcade sirens on the Channel #1 tape. If the motorcycle with the open microphone had been with the motorcade, it would be expected that the sirens' sound would have started at full volume and, if the motorcycle had continued with the motorcade, would have continued for the trip to

Parkland Hospital. On the other hand, if the motorcycle had remained at Dealey Plaza, the sounds would have started at full volume and the volume would have decreased as the motorcade pulled away. The sounds of the sirens on the tape, however, seem to increase, peak, and decrease, as if they were approaching, passing, and leaving the open microphone position. While this observation is admittedly somewhat subjective, if true it would indicate that the motorcycle was not with the motorcade, but was at some point along or near the route taken by the motorcade on its way to the Parkland Hospital.

The second significant finding also involved the sound of the sirens. In this case, the important factor was when they occurred. While it becomes obvious that the time designations provided by the Channel #1 dispatcher may not be completely accurate, an analysis of these time designations puts the beginning of the sounds of the sirens somewhere in the vicinity of 12:33; i.e., 2 or 3 minutes after the presumed time of the shots. Since it would be expected that the sirens would have been turned on as the motorcade began to rush away from the Dealey Plaza, or, in other words, a few seconds after the shots, the earliest acquisition of the siren sounds by the open microphone, two to three minutes later, again indicate that the motorcycle was along the route to Parkland Hospital, rather than a part of the motorcade.

In order to resolve the question of when the sirens were turned on, I contacted Chief Curry, who was the senior police officier in charge of the motorcade. Chief Curry informed me that immediately after the shots were fired, he transmitted (on Channel #2, motorcade channel) the statement that they were preceding to the hospital and that the sirens were turned on immediately. While there seems to be little reason to doubt Chief Curry's recollection, since it could be opined that in the excitment of the moment, none of the vehicles proceeding to Parkland Hospital had their sirens turned on until later, I procured the tape of the Channel #2 broadcasts to determine if the sirens could be heard during any of the motorcade broadcasts.

From this tape it was determined that Chief Curry broadcasted twice that they were proceeding to the hospital. The first transmission did not identify the hospital. A few seconds after the first transmission he rebroadcasted, identifying the hospital as Parkland. The sirens can be heard in both broadcasts and can be heard in subsequent broadcasts. (The sirens are more clearly discernable at the beginning of the the first broadcast. For this transmission Chief Curry keyed his microphone and paused for a moment before he talked. This allowed the sounds of the sirens to come through with significant volume. When he yelled into the microphone, the relative level of his voice

was higher at the microphone than was the sound of the sirens. The automatic gain control circuit in the transmitter then adjusted the audio gain in the accordance with the highest sound level received and, thereby, reduced the preceived level of the sirens. In the second transmission, the sirens are faint because Chief Curry vocalized immediately after keying the transmitter.)

At this point, I had determined that the sound of the sirens had begun within a few seconds of the shots, as stated by Chief Curry and confirmed by the sounds from the Channel #2 tape. If the motorcycle with the open microphone had been a part of the motorcade it would have transmitted the sounds of the sirens immediately. I had determined, further, that the sounds of the sirens were first audible in the open microphone transmission 2 or 3 minutes later than the presumed time of the shots, meaning, if the presumption of the time of the shots is correct, that the motorcycle with the open microphone on Channel #1 was located at or near the point where the motorcycle would be approximately 2 minutes after they had departed Dealey Plaza for Parkland Hospital. It is now necessary to deal with the presumption of the time the shots occurred.

From previous testimony, it has been established that the Channel #1 dispatcher read from one clock; that the Channel #2 dispatcher read from a second clock; that the clocks were analog (i.e., time is displayed by continous

movement of hour and minute hands); that they are synchronized once a month; and that the two clocks may differ by as much as a minute. Channel #1 taping was continuous; Channel #2 taping was initiated by an incoming or outgoing transmission and terminated following the end of the transmission. Thus, events which are not timed designated can be timed from a timed designation on Channel #1, but similar undesignated events on Channel #2 cannot be timed from a timed designated event, unless it can be shown that the transmissions are sufficiently continuous that the recorder remains in continuous operation. Additionally it must be considered that different dispatchers may use a slightly different system for determining the minutes which will be designated. For example, one dispatcher may consider that 12:20 will not be called until the minute hand has reached 20 and at all times will be designated 12:20 until the minute hand reaches 21. Another dispatcher may consider that when the half minute has arrived, the call will be for the next whole minute. In this case the dispatcher would designate 12:20 from 12:19 and 30 seconds until 12:20 and 30 seconds.

In attempting to identify the relationship between the time of the shots and other significant events, it is necessary to determine the time of the events on Channel #1 by Channel #1 time, the time of the events on Channel #2 by Channel #2 time, and the correlation between Channel #1

time and Channel #2 time, since there are no events on Channel #1 which pin point the time of the shots. The most significant event on Channel #2 is Chief Currys' call that they are preceding to the hospital, since this is known to have occurred a few seconds after the shots. The beginning of the sounds of sirens on Channel #1 is a significant event, as previously discussed. Also significant is the sound of a carillon type bell on Channel #1, since this allows determination of the time interval between the 10 second period considered by BB&N to contain the impluses which may represent the sound of the shots and the beginning of the sound of the sirens. In order to establish a base time for Channel #1, time designations by Channel #1 dispatcher of 12:26, 12:27, a second 12:27, and 12:28 are used. Considering the two approaches, previously discussed, to designating the time and the intervals between the calls, the following matrix results:

SEE THE CHART DISPLAYED IN FIGURE 1 ON THE FOLLOWING PAGE.

The dispatcher reported time is designated on lines 1 through 4. The interval is at interval timed from the tape between the dispatcher reported times. Columns A and B assume that the dispatcher changes his designation on the half minute and columns C and D assume that the dispatcher changes his designation on the even minute.

Starting with line #1, the dispatchers called designation is 12:26. This causes column A to be 12:25::30 and

FIG# 1

DISPATCH REPORTED TIME	INTERVAL	A	B	C	D
#1 12:26 PM		12:25::30 PM	12:26::29 PM	12:26::00 PM	12:26::59 PM
	20 SECONDS				
#2 12:27 PM		12:25::50 PM	12:26::49 PM	12:26::20 PM	12:27::19 PM
	18 SECONDS				
#3 12:27 PM		12:26::08 PM	12:27::07 PM	12:26::38 PM	12:27::37 PM
	22 SECONDS				
#4 12:28 PM		12:26::30 PM	12:27::29 PM	12:27::00 PM	12:27::59 PM

and column B to be 12:26::29. For the designation change on the minute, column C is 12:26::00 and column D is 12:26::59. The subsequent entries in columns A through D are arrived at by adding the measured interval to the line one times. Thus, if the dispatcher called 12:26 at 12:25::30, as designated in column A as the earliest Channel #1 clock time when the designation could have been made, then the line #2 time, occurring 20 measured seconds later must be 12:25::50 and line #3, 18 seconds later, must be 12:26::08, and so forth.

In examining to see whether the three designated times could have been called times indicated in the four lettered columns, we can exclude column A times, since 12:27 (line #2) would not have been called at 12:25::50; 12:27 (line #3) would not have been called at 12:26::08; and 12:28 (line #4) would not have been called at 12:26::30.

Column B is marginally acceptable. 12:26::49 would be called 12:27 (line #2); 12:27::07 would be called 12:27 (line #3); and 12:27::29 could be called 12:28 (line #4).

Column C is not acceptable, since, under the system represented by column C and D, 12:26::20 would not be called 12:27 (line #2); 12:26::38 would not be called 12:27 (line #3); and 12:27::00 would not be called 12:28 (line #4).

Column D is marginally acceptable under this system, since 12:27::19 would be called 12:27 (line #2); 12:27::37 would be called 12:27 (line #3); and 12:27::59 could be

called 12:28 (line #4).

We can now locate either of these times within a 30 second period to Channel #1 clock time and can, and therefore, measure the time intervals from either of these 4 events to any other event on the Channel #1 tape and, thereby, locate these other events within 30 seconds of the Channel #1 clock time.

Using the 12:26 designation, we have determined that the transmission occurred between 12:26::29 and 12:26::59. The measured time for this event to the bell is 4 minutes and 15 seconds and to the beginning of the sirens is 6 minutes and 2 seconds.

According to BB&N, the first impluse, which they considered may represent a shot, occurred 16 seconds before the sound of the bell and the last impluse, which they considered may represent a shot, occurred 6 seconds before the sound of the bell.

The chart in Figure 2 on the following page lists these events in the time period in which they occurred.

It is interesting to note that BB&N, using Least Square Analysis, a refined averaging process, computed the time of the first possible shot impluse as occurring at 12:30::47, Channel #1 clock time. My range for the same point is 12:30::38 to 12:31::08, with a mean (average) of

FIG# 2		
EVENTS	FROM	TO
12:26 PM TIME DESIGNATION	12:26::29 PM	12:26::59 PM
1ST POSSIBLE SHOT IMPULSE	12:30::28 PM	12:30::58 PM
LAST POSSIBLE SHOT IMPULSE	12:30::38 PM	12:31::08 PM
SOUND OF BELL	12:30::44 PM	12:31::14 PM
BEGINING SOUND OF SIRENS (CHANNEL #1)	12:32::31 PM	12:33::01 PM
ENDING SOUND OF SIRENS (CHANNEL #1)	12:33::11 PM	12:33::41 PM

12:30::53. Since we differ by only 6 seconds for our averages, our results are mutually supportive.

An interim conclusion may be made at this point:

- a. If the motorcycle with the open microphone were a part of the motorcade, it would have picked up the sounds of the sirens as soon as they began.
- b. The sirens began a few seconds after the shooting.
- c. The open microphone produced the taped sound of the siren at approximately 12:32::46 (plus or minus 15 seconds), Channel #1 clock time.
- d. Therefore, if the motorcycle were in the motorcade, the shots occurred a few seconds before 12:32::46. Since BB&N analyzed the 10 second section starting at approximately 12:30::53, Channel #1 clock time, almost 2 minutes before the shots would have been fired, it may be stated definitively that any impluses detected during that 10 second period were not the result of shots recorded by the open microphone. Of course, if the motorcycle were not within the motorcade, it did not record shots at any time.

I will return now to the primary problem of determining if the motorcycle open microphone could have transmitted the sound of the shots at any time (i.e., if the motorcycle were with the motorcade when it was in Dealey Plaza).

BB&N has determined by Least Square Analysis of transmissions giving time designations on Channel #2 that the approximate time of the assassination was 12:30 and 12 seconds, Channel #2 time. Since this conclusion was arrived at based upon essentially continuous running of the Channel #2 recorder, it would seem to be a reasonably accurate

estimate. Accepting it, for the moment, as accurate, and allowing a worst side error between Channel #1 and Channel #2 of 1 minute in either direction, the time of the assassination by the Channel #1 clock would be between 12:29::12 and 12:31::12. Allowing 10 seconds between the time of the assassination and the time the sirens were turned on and Chief Curry made his call, the latest the sirens could have started, by Channel #1 clock time would have been 12:31::22. If the motorcycle with the open microphone were with the motorcade, we would hear the sound of the sirens on the Channel #1 tape at that time, instead of between 12:32::31 and 12:33::01. In other words, the Channel #1 and Channel #2 clocks would have to be a full minute apart and the Least Square Analysis would have to be a minute to a minute and a half in error over a 6 minute analysis, and both events cumulative (in the same direction). Since this seems inconceivable, it is concluded that there is almost no possibility that the motorcycle was with the motorcade.

Since this conclusion cannot be stated quite as decisively, based upon the time elements, as the previous interim conclusion, the following supportive evidence is provided.

- a. The open microphone was on Channel #1, the normal police channel. The motorcade vehicles were on Channel #2, the special motorcade channel. If the motorcycle with the open microphone were with the motorcade, the transmission should have been on Channel #2.

- b. The sound of the sirens on the Channel #1 tape increases in volume and then fades out as would be expected if the motorcade were approaching, passing, and leaving the location of the open microphone.
- c. The sound of the bell on the Channel #1 tape requires that a bell be located with an acoustical range of the open microphone. There was no such bell in or near Dealey Plaza. While it has not been identified as the same bell, there was a bell in the tower of the Lucas Baptist Church, 4435 Rosewood (near the intersection of Lucas and Rosewood), Dallas, Texas, located 0.6 miles from the position of the designation of a three wheel motorcycle on traffic control duty on the Stemmons overpass over Industrial Boulevard.
- d. Several three wheel motorcycles were positioned in or around the Trade Mart and specifically in the area of the Stemmons Expressway and Industrial. One motorcycle officer has stated to me unequivocally that he was assigned and was specifically at the Stemmons and Industrial overpass and saw the motorcade traveling towards him, and away from him, going towards Hines Boulevard, as they were heading towards Parkland Hospital. He also stated to me that it is quite possible that it could have been his microphone keyed as he had several problems with his radio of the same nature in the past.
- e. The following transcript is of a transmission I located on Channel #2 and recorded on the tape recording included with this report for your review.

DISPATCH: 15 CAR 2.

15 CAR 2: 15 CAR 2.

DISPATCH: There is a motorcycle officer up on Stemmons with his mike stuck open on Channel #1. Could you send someone up there to tell him to shut it off?

15 CAR 2: 10-4

DISPATCH: 12:34

CONCLUSION

- A. It is concluded that the noise impluses detected during the period immediately preceding the sound of the bell were not shots.
- B. It is concluded that the motorcycle with the open microphone on Channel #1 was not a part of the motorcade, but was in fact, located along the route of the motorcade from Dealey Plaza to Parkland Hospital.

Additional information regarding my acoustical analysis, my investigative analysis, and my further investigation as to the location and identity of the keyed open microphone and spectrum analysis of the bell located at the Lucas Baptist Church, and questions for Dr. Barger (regarding his analysis et al), would be supplied upon an additional request.

Respectfully submitted to The Select
Committee on Assassinations,



Anthony J. Pellicano
President

AJP/jd

Mr. WOLF. Dr. Barger, have you had an opportunity to review the report submitted by Mr. Pellicano?

Dr. BARGER. I have read it.

Mr. WOLF. I would like to read parts of this report to you and ask you to comment on it. Mr. Pellicano characterizes his work as a deduction from your testimony, in addition to some independent investigation of his own. The first portion I would like to read is on page 4. I will read the paragraph and ask you to comment. It says:

The first significant finding involved the sound of the motorcade sirens on the channel 1 tape. If the motorcycle with the open microphone had been with the motorcade, it would be expected that the sirens' sound would have started at full volume and, if the motorcycle had continued with the motorcade, would have continued for the trip to Parkland Hospital. On the other hand, if the motorcycle had remained at Dealey Plaza, the sounds would have started at full volume and the volume would have decreased as the motorcade pulled away. The sounds of the siren on the tape, however, seem to increase, peak, and decrease, as if they were approaching, passing, and leaving the open microphone position. While this observation is admittedly somewhat subjective, if true it could indicate that the motorcycle was not with the motorcade, but was at some point along or near the route taken by the motorcade on its way to the Parkland Hospital.

Can you comment on that, please?

Dr. BARGER. I can't remember all that, but while I was still focusing on what you were saying, the statement was made that it would be expected that the motorcycle radio that we have placed in the motorcade would pick up the sounds of the siren on the chief's car that would presumably have been turned on just after the shooting. I think I heard that. Is that it?

Mr. WOLF. That is correct.

Dr. BARGER. The chief's car was in front of the Presidential limousine and would have been at this time at the underpass, or just beyond, a distance of at least 300 feet from the position of the motorcycle as we have placed it. Now the sound of a siren 300 feet away from a running motorcycle with as much background noise as there was in the Plaza at that time would not have been audible. In other words, I would disagree with the assumption that it could be heard. A little simple arithmetic indicates since the source level of sirens is around 120 decibels and the transmission loss from that particular chief of police car to the motorcycle would have to be at least 40 decibels, the sound pressure level of the siren at the position of the motorcycle could not have exceeded about 80 decibels, but we have seen that insensitive direction of the motorcycle microphone, it being a directional microphone and not sensitive to sounds from the front, was pointed at the chief's car. So that received sound level of 80 decibels would be considerably less than the ambient noise level in the microphone at that time, which was 90 decibels, and also would have been coming in on the insensitive access of the microphone. So I don't believe that that assumption that you would hear this siren is true. That was not a very short answer.

Mr. WOLF. So, therefore, you would also disagree with Mr. Pellicano's deduction that since the sound of the sirens occurred somewhere in the vicinity of 12:33, 2 or 3 minutes after the presumed shots, the motorcycle could not have been in Dealey Plaza?

Dr. BARGER. Yes.

Mr. WOLF. I would like now to read from page 14 of the submission to the committee and ask you to comment upon this statement. It concerns a question I believe Congressman Dodd in part addressed this morning about the ringing of a bell that appears on the tape. The report states:

The sound of the bell on the channel 1 tape requires that a bell be located within an acoustical range of the open microphone. There was no such bell in or near Dealey Plaza. While it has not been identified as the same bell, there was a bell in the tower of the Lucas Baptist Church, 4435 Rosewood (near the intersection of Lucas and Rosewood), Dallas, Tex., located 0.6 miles from the position of the designation of a three-wheel motorcycle on traffic control duty on the Stemmons overpass over Industrial Boulevard.

Can you comment on that passage?

Dr. BARGER. The sound of the bell occurred a few seconds after the time of the fourth shot. I don't remember exactly when. It indicates that there was a transmitter on a motorcycle or perhaps in a squad car or possibly also a walkie-talkie, but a transmitter that was transmitting a little after the fourth shot that was within sound range, audible range, of a bell. I agree completely with Officer McLain's statement that more than one transmitter can share a receiver at one time. This is true whenever the strength of the carriers of all of the radios in question are within the capture ratio of the receiver in their intensity.

Mr. WOLF. Thank you, Dr. Barger. I would now like to address the testimony Professors Weiss and Aschkenasy gave this morning. Have you had an opportunity to review the work of Professors Weiss and Aschkenasy?

Dr. BARGER. Yes; I have.

Mr. WOLF. What did you do to review independently their work that was done for this committee?

Dr. BARGER. In the first place, shortly after my testimony at the previous hearing, I met with Professor Weiss and Mr. Aschkenasy and members of the committee staff, to discuss how best we might reduce the uncertainty in the results that we had obtained at that time, in particular relating to the possibility of a third shot, which is listed in green in that exhibit. We contributed in that discussion to the concept of an analytical extension of our work, which is, in fact, the analytical extension that they carried out. So we were familiar with the parameters that they would need to know and also with the procedure that they intended to follow. I asked them what parameters they were using and found in each case that I agreed with them. In other words, we checked their procedures and the parameters that they used.

In addition, and perhaps most importantly, at the stage where they had finished with all their strings—as they were illustrating this morning—and had identified the echo-producing objects in the plaza that caused the echoes at positions near microphone 4 there, where we found the shot may have occurred and where it may have been received, we looked at those echo-producing objects for that location that they found with their very accurate and diligent procedure and made a judgment about each one as to whether it would be able to produce an echo of sufficient strength to be heard in the motorcycle microphone, considering the direction from which it had to arrive at the motorcycle microphone, considering

what we now know the direction the microphone is pointing at that time. We found that the echo-producing objects that they identified were reasonable and would, in fact, produce echoes of sufficient strength to be seen, or heard, I should say.

Mr. WOLF. In your testimony on September 11, addressing particularly the third impulse in the Dallas Police dispatch tape, you stated that the probability of this being a shot from the grassy knoll was 50-50. Professor Weiss and Mr. Aschkenasy, today, whose testimony you heard, stated that the probability of this being a shot from the grassy knoll was 95 percent or better. You have reviewed the work of Professor Weiss and Mr. Aschkenasy. Do you agree with their assessment?

Dr. BARGER. Yes; once we checked their procedures, their parameters and their echo-producing objects, we received from them the results of their match. Drs. Kalikow, Rhyne, and Mr. Schmidt and I, at Bolt, Beranek, and Newman, reviewed their results, and we concluded that they had successfully achieved a match having a correlation coefficient of 77, and you remember that was the number I was using of goodness of match. We also found that they had done this with only a plus or minus one one-thousandth of a second error for each match, whereas we had used a plus or minus six one-thousandths of a second error, if you will, or acceptance window as Professor Weiss called it, in order to achieve our matches. Now, the reason that we used the large acceptance window of six one-thousandths of a second was because we didn't know, as I said, exactly where the motorcycle was. The reason they were able to lower theirs to one one-thousandth of a second was because they found exactly where it was by the procedure they described this morning. The effect of reducing this acceptance window is to greatly reduce the likelihood that noise bursts that occur could mimic the fingerprint of a shot from any place and received at that microphone. It reduces it very substantially. In other words, in the terminology that I used last time, their ability to achieve this match within plus or minus one one-thousandth of 1 second reduces the false alarm rate substantially. In other words, we had a large false alarm rate because we had a large acceptance window because we didn't know exactly where the motorcycle was. That gave us a large false alarm rate. They corrected that problem by lowering the acceptance window. There is another feature of that score besides the acceptance window. That is important. That is the value of the correlation coefficient achieved. As I said, we would not accept as a potential match any correlation coefficient that was less than one-half. But we didn't require it to be one, either, which is what it would be if there was no noise. Noise is the thing that causes the correlation coefficient to be less than one. Noise is on the Dallas Police recording. Professors Weiss and Aschkenasy did nothing to reduce the noise, so I would not have expected they would have increased the correlation coefficient. In fact, they accepted more noise than we did, and that could have affected the correlation coefficient, which should have gone down. So their correlation coefficient, while high, was not unity. On the other hand, the false alarm rate one would expect from their match, which was so tight, this would make the likelihood of random noise

bursts to fit all 10 of those to within plus or minus one one-thousandth very small. I think I forgot the question.

Mr. WOLF. Your ability to state with 95-percent certainty, now, what was only a 50-50-percent probability in September was, in essence, due to the narrowing of the match time from six one-thousandths of a second to one one-thousandth of a second. Is that, in essence, correct?

Dr. BARGER. Yes, sir. After looking at what they had done, and the fact they had maintained a high correlation coefficient while reducing the acceptance window, resulted in our independent calculation of the expectancy that they could have achieved the match they got only 5 percent of the time by random if it had just been noise on the tape and not a gunshot from that place. That is why we stated independently, although their number was quite similar to ours, that we felt that the likelihood of there having been a gun shot from that knoll and received at that point now to be about 95 percent or possibly better.

Mr. WOLF. Thank you very much, Dr. Barger. I have no further questions.

Mr. PREYER [presiding]. Dr. Barger, we appreciate your being here again. I was interested in Mr. Wolf's questions to you at the outset about the Kent State hearings and your work there. There has been a lot of discussion of the acoustics technique as a relatively new technique applying old principles and that the Kent State case was perhaps the first in which it was applied. Now, I understood you to say that in that case your analysis of the timing and location of the shots was stipulated as being correct and was admitted into evidence.

Dr. BARGER. That is correct.

Mr. PREYER. Was that a criminal case? What was the nature of the case?

Dr. BARGER. I should know the answer to that, of course; however, I am a physicist. It was an indictment brought by a Federal court, I believe. You know you might, if you would, ask that question of the Chief Counsel of this committee. He might be able to answer that better.

Mr. BLAKEY. I think Dr. Barger is correct. The matter was considered both in the State and Federal level. My memory is that there was a Federal indictment returned under the Civil Rights Act, and I think ultimately the jury found the guardsmen not guilty. The case has also been tried at the civil level in the State, and it is presently in litigation now.

Dr. BARGER. This was not the civil case.

Mr. PREYER. What I was getting at was how your acoustics testimony was used. Could you briefly outline to us what it showed? Were you able to locate individuals who could have fired shots from your acoustic study?

Dr. BARGER. What we did was locate the physical positions where rifles were fired from, where the first one was fired from, the second one, the third, and the fourth. Then it was quite a fusillade, and it got indistinct. But we located the physical positions and someone else with photographic evidence made the connections between individuals and physical locations. Exactly how they did that and in what way that was used, I don't know.

Mr. PREYER. Do you recall, and perhaps this is unfair to ask a scientist rather than a lawyer, but do you recall in what form the judge charged the jury concerning that acoustics testimony, as to how they could consider it?

Dr. BARGER. Well, in fact, Judge Pryer—I was there, assuming that I would be testifying. I had written my results into a record which had been examined by both sides. When it was time to call me, the defense stipulated the information in the report. So I went home. However, as I recall, I don't know what the judge said. I went home at that point.

Mr. PREYER. Well, it sounds as if your acoustics testimony actually located the direction of the shot and then the photographs simply put the name of the person located there.

Dr. BARGER. That is correct.

Mr. PREYER. In other words, that was—your testimony was key, I would think.

Mr. DEVINE. Will you yield?

Mr. PREYER. I will be glad to.

Mr. DEVINE. Dr. Barger, was the stipulation that your testimony would be so-and-so if you testified, or was the stipulation as to the accuracy of your testimony? There are two different kinds of stipulations. One would be if Dr. Barger testified, he would say thus and so. Another stipulation is one by agreement that it is agreed that your testimony which was supplied was accurate.

Dr. BARGER. I just don't feel that I can answer that question. I don't know that for sure.

Mr. DEVINE. Thank you.

Mr. PREYER. Thank you, Mr. Devine.

Mr. FAUNTROY?

Mr. FAUNTROY. Thank you.

Dr. Barger, you found the fingerprints of four outbursts that you believe to have been supersonic shots, is that so?

Dr. BARGER. No; let me—that is a good question.

These echo patterns that I called, suggested might be called fingerprints, can contain a precursor which is an end wave or a shock wave caused by a supersonic bullet, or they might not. If the rifle was—did, in fact, fire a supersonic bullet, and if the trajectory of the bullet was at an angle from the receiver that was less than about 80 degrees, you would see that precursor, the end wave, the shock wave caused by the supersonic bullet. If the microphone, in effect, was behind the rifleman and the trajectory was away from the microphone, you would not see that precursor, even though it was a supersonic bullet.

Mr. FAUNTROY. All right. On the charts which Dr. Weiss set before us we saw the indication of a burst preceded by—

Dr. BARGER. Yes.

Mr. FAUNTROY [continuing]. What was described to us as shock waves.

Dr. BARGER. Yes.

Mr. FAUNTROY. Could those lines have been produced by noise other than that of shock waves?

Dr. BARGER. Yes.

Mr. FAUNTROY. What indication do you have from the patterns that you noticed in the four shots that would lead you to suggest to

us that in all probability those waves were shock waves or those lines were produced by shock waves?

Dr. BARGER. Yes; well, your question is right at the heart of the matter. In the fourth shot our findings indicate that that is in all probability a shot from the sixth floor of the Texas depository at the vicinity of the limousine, near frame 313.

Now, we know the muzzle velocity of that rifle, and so now we can look at our fingerprint smudged on the Dallas police tape, and we can see the indication of a shock wave that precursus those impulses, and we can calculate when, you know, when it should occur because we know everything about it, we know all of the geometry and the speed of the bullet and it calculates out just right. So we know what a shock wave looks like on that Dallas police tape recording, because we are virtually certain that we see it on the fourth shot, as we should.

Now, the precursor that Professor Weiss and Mr. Aschkenasy were looking at this morning looks just like that, looks like it could be, it looks like a shock wave. It occurs at a time before what appears to be a muzzle blast that is consistent with reasonable trajectories and muzzle velocities, so it is entirely consistent with the shock wave, with the impulse made by a supersonic bullet fired from a rifle.

Mr. FAUNTROY. So in short, your answer is that the shock waves which we have identified on the shots that we know about resemble sufficiently the shot No. 3 to conclude that that, too, was in all probability a shock wave?

Dr. BARGER. Yes. That is just what I said. You asked the question a little differently the first time.

Mr. FAUNTROY. I know it.

Dr. BARGER. And let me answer that, also.

You asked if there is anything else that could resemble the shock wave of a supersonic bullet, and my answer would have to be yes, it is possible that a burst of static would occur of that amplitude and at that time. And, therefore, it is conceivable that although that is consistent with being a shock wave in any way, it is conceivable also that that is a noise burst.

Having said all of that, I feel compelled to answer your next question, which is how likely is that to be a noise burst. Well, the best I can do here, and I think it is the best anyone could do, is to look at the record to find what is called the marking rate, in other words, the average number of such noise bursts that occur in a unit period of time. In other words, how many of those per second occur anyway?

Well, you answer that question by looking at someplace on the tape where there may be a few impulses, but they are clearly not the fingerprints of gunshots, and so you look there and you say how rapidly do things like this occur that resemble end waves. Well, I have done this, as this was going to be your next question, and I had to have an answer for it. It appears in a very conservative way that these are happening, you have this amplitude that Professor Weiss and Mr. Aschkenasy showed on that exhibit.

In fact, it probably would not hurt to have that exhibit up. I have no idea what the number is, but it is the one with all the wiggly lines, not to suggest that they only had one exhibit with

wiggly lines. But in any case, the precursor that we are talking about only, a similar precursor when they are obviously noise bursts certainly occur no more often than about every 120 one-thousandths of a second.

Now, the total time span over which a noise burst could mimic a shock wave, given any reasonable muzzle velocity and direction of the fire, is on the order of 25 to 30 one-thousandths of a second. And so by a fairly straightforward chain of logic, the odds that a noise burst of those characteristics falling into that time span so they could mimic a shock wave are less than one in four, probably one in five, and I get that simply from observing the marking rate or the rate at which random noise bursts occur. That is the one that might conceivably mimic a shock wave.

Mr. FAUNTROY. Thank you, Mr. Chairman. I know my time has expired.

Mr. PREYER. Thank you. Mr. Devine.

Mr. DEVINE. I just have a couple of short questions.

Doctor, when you had your reenactment on August 20, do you recall what the temperature was?

Dr. BARGER. It was very hot. It varied. At the beginning of the day when we were testing in the microphone right down near Main Street it was about 73°, I recall, the first time I looked. At the time we finished, we were over on Elm Street, it was noon, and it was 90° the last time I looked.

Mr. DEVINE. There was a lot of fuss made this morning about what the temperature was on November 22, and they concluded it was roughly 65°?

Dr. BARGER. Yes.

Mr. DEVINE. In your reenactment, would that make any difference in your conclusion, the fact that the temperature is measurably different?

Dr. BARGER. Yes; the speed of sound is important to my process, and, therefore, it has to be computed correctly. Now, of course, the relevant choice in this, what is the precision that one needs in order to achieve the purpose that we have set out to achieve? In the case of the reconstruction, as used by Professor Weiss and Mr. Aschkenasy, they needed to have that temperature accurate enough so that when they swung their strings around they would hit something at all, because the only thing that they used my data for other than the fact that I told them about where the motorcycle was, you know, within 18 feet, was what that one echo pattern looked like, that one fingerprint from microphone 4, and if they did, if I had known that it was 90° when I fired that shot, but told them it was 65°, their string would have come up short, and it would have missed that building, and so it was necessary to get it approximately correct.

Now, the question really is how correct does it have to be, how accurate?

Now, it is easy to show, since the speed of sound goes like the square root of the absolute temperature, that if you make a 5° error in the temperature, then your error in speed of sound will be one-half of 1 percent.

Now, Professor Blakey correctly described the process by which I determined that it was 65° during the assassination. Supposing

it were 70°. I think 5° is the outside of our uncertainty. Then the error in the sound speed would be one-half of 1 percent. Now, since my uncertainty in location was 18 feet, and since the difference in travel distance of sound over the paths we are talking about at the level of one-half of 1 percent is only $2\frac{1}{2}$ inches, I cared not one whit about one-half-of-1-percent errors in the sound speed. On the other hand, the whole purpose of Professor Weiss and Mr. Aschkenasy's procedure was to add precision to the procedure that we developed, analytically to compute with great precision and in very narrow time windows where these echoes must fall if, in fact, fingerprint comparison is to be declared a valid match. And they achieved, as I recall, a location accuracy of something like plus or minus 6 to 10 inches. So the 2- or 3-inch error that could be induced by a 5° uncertainty is scarcely noticeable, even to them.

Mr. DEVINE. In another vein, Dr. Barger, I think the testimony originally was that Officer McLain was putting along at 11 or 12 miles an hour in the motorcade. After the shot was fired they took off for Parkland Hospital when it was necessary for them to rev up and had trouble catching the limousine. Did I understand you to say that even with the open mike that there was no measurable difference in motorcycle noise, that the decibels were such that it wouldn't make any difference if we are talking about that motorcycle having the open mike on it? It would seem to me as a layman that there would be considerably more motorcycle noise when he took off for Parkland Hospital.

Dr. BARGER. Well, there definitely was. I believe in my previous testimony I did not focus on what the motorcycle may or may not have done after the shooting on the basis of the sound that it made. On the other hand, you have just focused me on that.

The noise level of the motorcycle as perceived through the radio was rather high up until about 2, about 3 seconds before the first shot was fired. In other words, the motorcycles have greatly reduced speed 3 seconds before the first shot was fired, which was a very fortunate thing in the sense that it made it easier to see these smudged fingerprints of gunfire, because otherwise they would have been more obscured by the noise.

Now, that motorcycle noise stayed down in this reduced level, it did not go off, it stayed down, but it stayed down at this reduced level, and it was reduced by about 10 decibels, which we measured—the noise level was reduced by 10—decibels, and it stayed that way for about 30 seconds, 30 or 40 seconds, and then it rose again to as loud a level as it had previously been and even greater, and stayed that way for several minutes. In other words, the motorcycle stayed at a low speed for less than a minute, certainly, about a half a minute, after the shots, and then it speeded up again and it went even faster than it had before, and it continued to do that for at least 2 minutes.

Mr. DEVINE. Well, you do not have any trouble then in identifying Officer McLain's motorcycle as the one on which the open mike existed. Is that correct?

Dr. BARGER. Well, I have no way of knowing from the sounds that came through the radio what motorcycle it was that was making that noise, that is correct.

Mr. DEVINE. But you were here when Dr. Weiss testified this morning. Did you agree with his conclusions on that?

Dr. BARGER. I think I would be safe if I asked you to remind me what his conclusions were on that. My attention may have wandered.

Mr. DEVINE. If my recollection is correct, I think he said it was logical to assume that the motorcycle was in the position where Detective McLain was or Officer McLain was to show the results that appeared on their charts and findings. At least that is my assumption from having listened to him.

Dr. BARGER. I am sorry. I am not certain enough that I understand that question that I should attempt to answer it.

Mr. DEVINE. Well, the bottom line is this: we have established without much question that there was an open mike on a motorcycle someplace.

Dr. BARGER. Yes.

Mr. DEVINE. And it is important to identify what open mike was recording the shots from 1, 2 and 4 as well as the No. 3 shot which is alleged to have come from the grassy knoll.

Dr. BARGER. Yes.

Mr. DEVINE. Now, that is the receiver, that mike is the receiver.

Dr. BARGER. Yes.

Mr. DEVINE. It is important to identify it, and apparently Dr. Weiss and his colleague are satisfied that it was the motorcycle behind the limousine on the left side, and I was wondering if your findings would follow that same logic.

Dr. BARGER. Yes, yes, yes.

I thought that was what your question was. I just wanted to make sure.

The position that we had originally found for the motorcycle as a function of time, we do not feel our estimate of the motorcycle position, I do not believe is modified by Professor Weiss and Mr. Aschkenasy's testimony. In fact, perhaps corroborated. And I, in listening to Officer McLain, I find that his memory of where he was relative to the time of the shooting does, in fact, correspond with the position where we found a motorcycle was, and since he did not know of any, he did not report a motorcycle within 5 or 10 feet of him, it must have been him.

Mr. DEVINE. Right. Thank you very much.

Chairman STOKES. Time of the gentleman has expired.

The gentleman from Connecticut, Mr. Dodd.

Mr. DODD. Thank you, Mr. Chairman.

I was tempted to ask you now to translate everything you have just said for the last 20 minutes in layman's terms. I noticed your definition of a correlation coefficient is the number of echoes matched with impulses over the square root of the number of echoes times the number of impulses.

Dr. BARGER. Yes.

Mr. DODD. I thought that was what your answer would be.

Dr. BARGER. Oh.

Mr. DODD. I wanted to give you a chance to sound positive. One is the perfect match, that is when you would have between the Dallas Police Department tape and the predicted tape, if they matched absolutely exactly, you would end up with 1.

Dr. BARGER. Yes.

Mr. DODD. So we are talking 0.7's, 0.8's, 0.6's, and 0.5's; we are coming within that percentage of a perfect match.

Dr. BARGER. Yes.

Mr. DODD. OK. I would like to take first of all, if I could, on the very first shock wave that you record, there is no muzzle velocity that appears, or is it the shock wave that I am distinguishing? Anyway, there is on that first strong impulse that you identified originally as coming from the Texas School Book Depository, it lacks that shock wave.

Dr. BARGER. Yes.

Mr. DODD. You explained that as being the fact that the receiver, in this case the motorcycle, was probably not in proper enough position to pick up the cone.

Dr. BARGER. Yes.

Mr. DODD. Is that correct?

Dr. BARGER. That is correct.

Mr. DODD. How can you explain it within 1.6 seconds immediately thereafter we get that kind of an impulse?

Dr. BARGER. May I walk over there and—

Mr. DODD. Sure.

Dr. BARGER. The position that we estimate as the motorcycle position at the time of the first shot is about here. The first, the trajectory of the first shot would be about as indicated by this pointer because the limousine was over here at about, oh, in the vicinity somewhere around 160, I believe.

Now, this angle from the trajectory to the microphone, if it is greater than, in fact, 60 degrees for a Mach 2 bullet, you will not hear it, and that angle is just slightly greater. So you are right on the edge of hearing that shock wave. It would be very weak, since you are on the edge, so you undoubtedly would not see it.

After the 1.6 seconds that you have described, at a speed of 11 miles an hour, I believe that is—

Mr. DODD. Now he is slowing down, he is coming around the curve now.

Dr. BARGER. Correct, correct, and he has, according to our matching procedure, achieved a position somewhere between 2.6 and 2.10; 2.10 is over here, and 2.6 is here. So he has moved to somewhere around here where I indicated on the red dot. That is still, is just on the edge of the 60° angle, and so you would not expect to see it, and you do not. The first two do not show a precursor that could be considered to be an end wave from a supersonic trajectory.

Now, on the third one, however, the motorcycle had achieved a position which, in my—well, I mislabeled that last time, I should have been right here between 4 and 5, near 4, this is where the motorcycle was at the time of the third shot. That one appears to have emanated from here, and that is well within that angle, in other words that shock wave will come right back by and hit it. The fourth, by the time the fourth shot was fired, the motorcycle is here, and the shot came from the depository here, and you are almost right underneath the flight path of the bullet, and, boy, and that you would hear, and it is observed in the data.

Mr. DODD. All right. Unless you want to stay there, I do not know any reason why you have to, but let me ask you what I asked

Dr. Weiss this morning about the availability 15 years ago of the expertise that you have used to arrive at the conclusion you did in September and again today. Could the Warren Commission have conducted similar tests then with the available information they had in 1963-64 and have arrived at a similar conclusion that you and Dr. Weiss have arrived at?

Dr. BARGER. Yes.

Mr. DODD. There has not been any significant improvement in the science that would have prohibited them from utilizing this kind of testing?

Dr. BARGER. No.

Mr. DODD. OK.

We have heard and we keep on repeating it ourselves, and I asked the question of Dr. Weiss, and I will ask it again of you, we have talked about the probability of the third impulse, in fact, all four impulses that were talked about, but the third impulse particularly today, is a loud noise from the grassy knoll, and that is 95 percent sure, and I do not think I got an answer this morning, I may not have pursued it far enough, what is the probability that, that our noise from the grassy knoll was, in fact, a rifle shot?

Dr. BARGER. Yes. Well, Congressman Fauntroy was working on that one, too. Our independent estimate of the probability that an impulsive sound behind the fence on that knoll of loudness as great as that from a rifle that was, in fact, discharged and received where we have indicated, is 95 percent or better. Now I did not say a rifle, I said an impulse that is as loud as one. And now, you know that maybe—

Mr. DODD. We have kept on talking about 95-percent probability that a rifle shot is being fired. I am assuming the rifle shot, and I am wondering whether or not we can assume the same to be a probability.

Dr. BARGER. I am not sure I said that.

Mr. DODD. We have been, at least.

Dr. BARGER. We find that the likelihood that an impulsive noise came from that location and was received where we indicated or actually where Weiss and Aschkenasy indicated, you know, which is 5 feet away from where we had estimated, and that is as loud as a rifle, is 95 percent or better.

Now, I am not prepared to tell you how many cherry bombs in series it takes to simulate a rifle, because I have not experimented with those since the days of my youth. But the fact is it is conceivable that one could generate such a noise.

However, those cherry bombs would not emanate a supersonic trajectory which would cause a shock wave, which is indicated in the data. So when I asked Congressman—answered, I mean—when I answered Congressman Fauntroy's question about the likelihood that that impulse that seems to be a shock wave might, in fact, be a noise burst that's masquerading as a shock wave, I made an estimate of how likely that would be, and I came out about one chance in five, or an 80-percent probability that that is caused by a muzzle blast and only a 20-percent probability that it was caused by noise.

So, to answer your question, I think there is a 95-percent probability that a loud impulsive sound emanated from that point. But,

I have to multiply that by the probability that given there was a noise, it was also a rifle. The only evidence I have that it was likely to be is the presence of the shock wave.

Mr. DODD. All right, but now—

Dr. BARGER. And that is a point approximately, if I may perform that multiplication, I get something like 78 percent, so to answer your question literally, I have to say my estimate is about 78 percent likely to be a rifle.

Chairman STOKES. Time of the gentleman has expired.

Mr. DODD. May I proceed for an additional 2 minutes, Mr. Chairman?

Chairman STOKES. Without objection, the gentleman is recognized 2 additional minutes.

Mr. DODD. We have no end wave in 1 and 2.

Dr. BARGER. Right.

Mr. DODD. What does that do to the probability of that being a rifle?

Dr. BARGER. Nothing. We do not expect an end wave in 1 or 2 because the receiver is in the wrong position to hear it.

Mr. DODD. OK. But does that not increase the probability that there could be a like noise that would have created the same impulse, since there was no recorded end wave?

Dr. BARGER. If anything, it decreases it, because there was not any like noise that popped up and masqueraded as a shock wave in 1 and 2. If there had I would have said, would have said no, no, no, it should not be there, because the geometry is wrong. So if it was there I would have said this is a noise burst masquerading as a shock wave, but none did.

Mr. DODD. Let me try and just wrap up this way with you. The reason we are here today, in effect, is because back on September 11, when we finally got down to this third grouping that pointed to the possibility of a shot coming from the grassy knoll, I forget which member of the committee pursued you on this whole question of probabilities then, but you arrived at the 50-50.

Dr. BARGER. I think you took turns.

Mr. DODD. Could you now go back for us, if you would, and give us your assessment on all four of these impulses, with the degree of probability again, now including the assessments or reassessments of Dr. Weiss and associate.

Dr. BARGER. Yes; the first point is that their refinement of our technique that they applied to the third shot, which has indicated that it in all likelihood was a shot, does not affect materially my estimates of the likelihood on the other three.

Now, in case that answer boggles your mind—if it does not, I will not elaborate.

Mr. DODD. Oh, elaborate. If it does not mine, I am sure it does somebody's.

Dr. BARGER. OK. My reasoning had gone this way: I had achieved 15 correlations over my threshold level of .5, each of which was a potential shot. I do not mean to say that. Each one was a potential match with a test shot, and if several came at one incident time, as they did, they all together were just indicating the same shot.

Since I had used the plus or minus 6 millisecond time window—which might also be called, unelegantly I would say, a fudge factor—it allows the test patterns from two adjacent microphones to resemble one another, and, in fact, you do see that when we get more than one correlation coefficient passing my threshold, that they do tend to be from adjacent microphones.

In any case, 15 times our test for matches of fingerprints with or smudge fingerprints were successful.

Now I went through an argument then with red X's that indicated that 6 of those 15 were certainly false alarms, the word that I use to describe a situation when my matching process indicated a match, when, in fact, it should not have, and I was using independent evidence from pure acoustical evidence in order to make the judgment that those 6 were false alarms, as in fact, you may recall that if one of them had not been a false alarm and in fact had been true, the motorcycle would have had to go 55 miles an hour to get from one place to another in the time that was available, and it clearly did not do that.

So using that kind of reasoning, I found that 15 of those, 6 of those 15, were obviously disjoint and, therefore, clearly false alarms.

OK. I had 15, and 6 were obviously false. Therefore, I knew that my system, which was designed to catch motorcycles, had a propensity for false alarms. And what was that propensity, I had to make a judgment. I said of that remaining nine that were not of the six that I was sure were false alarms, some of those, too, must be false. I judged that probably about 3 or 4, which would give me, or 2 or 3, which would have given me 8 or 10 false alarms, and 6 or 7 correct detections. That was a judgment, and so I said it is close enough to be 50-50 that I will judge that the false alarm rate in this experiment is 50 percent.

Now, when I had a shot indicated by one single match of my fingerprint with the smudge print on the Dallas tape, the only one I could only put a 50-percent probability on was that one. On the other hand, the first shot had three that were not judged to be false alarms.

Mr. DODD. So what percentage would you give to that?

Chairman STOKES. Time of the gentleman has again expired. I will permit the answer.

Dr. BARGER. He will probably ask for more.

Mr. DODD. What percentage, I am just trying to get back, does this change all of the percentages you gave us?

Dr. BARGER. This is a long-winded answer, because as indicated it would be, but the answer is no, it does not change it and here is why. I had made the judgment, if my false alarm rate was 50 percent the first time because I had six that I knew were false, and I suspected there were a couple of others in there, and that made it half false, half true, 50 percent.

. Now, all Professor Weiss and Mr. Aschkenasy have done is prove that one of those is not false. That does not materially change that situation, so I still think the false alarm rate is about 50 percent.

Now, when, if I make an assumption that each of the 15 events that we see on that board are independent, then I or anyone else can calculate the probabilities that each of those shots did occur. In

the case of the first one, where there were three indications of .5 each, that works out 87½ percent likely, and one-eighth unlikely. In the case of the second shot there were likewise three that were not, three correlations that passed the test that were not impeached as obvious false alarms and, therefore, the operative or probability on that one is also 87 percent. In the case of the last one, there were two that were unimpeached, so the probability works out to 75 percent, and in the case of the third one there was only one, so that was 50, it was 50 percent.

And did I make a mistake on the second one? OK.

Chairman STOKES. Time of the gentleman has expired.

Mr. DODD. I am not going to ask for any more time.

Chairman STOKES. Gentlemen, we are going to have to try to move along a little faster here. The gentleman from Indiana, Mr. Fithian.

Mr. FITHIAN. Thank you, Mr. Chairman.

We are sure, you are confident that the sounds, the shapes of the sounds that you measured are gunshots, in plain language, that is what you are telling us?

Dr. BARGER. Quite confident, yes.

Mr. FITHIAN. And that is to the exclusion of any other sounds short of a bunch of cherry bombs that would have set up that kind of impulse, but would still have been missing for shots 3 and 4 the shock wave, is that correct?

Dr. BARGER. That is correct.

Mr. FITHIAN. Now, I am concerned that we clarify one thing. You recall the Sunday evening preceding your testimony, before we met and went over all this, and I apparently did not explore as much as I should have with you the probability questions that came up the next day. And, therefore, I was a little bit dismayed that we dropped to 50-50.

Since we are closing out this investigation now, I do not mean to be harsh, but I want to quote back to you what you told this committee on September 11, and ask if you would like us to take away from here a different impression than what I see in this record. It is late in the day and you are being asked whether or not there is any test that we could take to reduce the uncertainty, because as you know, as you remember, the committee was disturbed with the 50-50 chance that there was a fourth shot. And at that point you had said, it is correct, there was a 50-50 chance that there was a fourth shot. Congressman Edgar then asks you this question: "Is there any test that we could make that could reduce the uncertainty?" To which you replied: "Congressman, the answer to that literally is yes. Now that the position of the motorcycle has been fixed with some confidence, one would not bother with microphones all over other parts of Dealey Plaza, for example."

Then you said: "However, I believe that the advantages to be gained from rectifying that problem are very marginal, and I doubt if they could reasonably be expected to improve the level of uncertainty in the test."

Now it is of great importance to this committee that we distinguish between a 50-50 probability of a fourth shot and a 95-percent certainty of the fourth shot. Could you clarify for me or harmonize your testimony here today that you agree with the 95-percent

probability of the third shot with what you told us in September, which was, in essence, that additional testing and whatever would not increase the marginality of the probability?

Dr. BARGER. Yes; first, that answer of mine sounds pretty good to me, if I may tell you why. I perceived that I had been asked if more shooting would be valuable. By that I mean, you know, we were talking about a test and I thought that the question was would more shooting be valuable and I said—I mean I intended to say no to that. Because even though the uncertainty in the location of the motorcycle had been greatly reduced by what we had done then, there was still quite a bit.

When I said, "Literally yes," I am glad I said that, because one could always do exactly what Professor Weiss and Mr. Aschkenasy did. However, I had not conceived of that analytical extension of what we had done at that time, and when Mr. Edgar asked me that question I did not synthesize that procedure in my mind at that time. However, shortly after discussing it with Professor Weiss, and he did think up, I agree, readily that that was literally possible, but I was not too enthusiastic, because the motorcycle might have been over on near the curve, which would have put it 20 feet away at the least, it could have been as much as almost 30 feet from that microphone, and if he were to undertake his procedure, diligent as he is, and was, and it had, in fact, have been 30 feet away, he might still be looking.

Now it turns out it was only 5 feet away. I did not know that at that time. And I did not want to say, oh sure, you know, go ahead and try that, because the range of time it would take to succeed could vary between a few days and a few months. However, I do want to acknowledge very clearly that the particular extension of my procedure that Professor Weiss used was his own idea and I think a very good one, and as soon as I heard it I was very, very quick to realize its potential value. But even then I did not know how long it was going to take him to do it.

Mr. FITHIAN. Finally, this committee will soon have to decide what we are going to do with this rather startling evidence, and I am sure, given the nature of the world, that we will soon have our critics, within weeks, if not days, and certainly within months and years. Where will those critics be attacking this particular part of our work, that is you, as our consultant, and our conclusions, whatever they may be as a result of this testimony?

Dr. BARGER. Well, that is a very good question. I sure would not want to give anybody any ideas.

Mr. FITHIAN. Well, if I may just interject, I am just sure that the startling nature of this information will prompt the most careful scrutiny that has been yet applied to the Kennedy assassination.

Dr. BARGER. Of course it will, and it should. It will take me a little while to answer this question because I want to, you know, to try to think of the most important items.

The reason I have to think is because—this long—is because up till recently I felt that the major shortcoming of our work, and when I say "our," I mean Bolt, Beranek and Newman's and Queens College and the committee staff's in particular, was that there was no evidence that there was a motor vehicle where we had found it to be. And I must say that would have been I thought a very

obvious place from which to attack the analysis. I feel now that that particular issue is no longer at the top of my list.

I think the most serious problem, the most serious problem we have as analysts is determining these probabilities.

There are two kinds of assumptions you can make when you compute the probabilities that we have computed. One is that each event that occurs is statistically independent of all of the others, and the other assumption is quite the opposite, that they are not independent events, but they are all related. And if you make either of those two assumptions, you can get an answer and it is not always the same answer. And determining whether these events, and by events I am talking about the occurrence of noise spikes on the Dallas tape, in determining whether these are statistically dependent, in other words, do they resemble each other here and here and here or do they just come at random, is a question that can be answered mathematically only if you have enough of the data, and we do not have enough.

So, the hardest thing for us to do is to give accurate calculations—well, we can give accurate calculations, but we have to make assumptions, and the assumption of statistical independence, randomness in the noise, is an assumption that I have made when I analyzed my own results, and also those of Professor Weiss and Mr. Aschkenasy. People have been complaining that we did this. I do not think they can improve on it, because there is not enough data to answer the question. But literally, it is a problem.

Chairman STOKES. Time of the gentleman has expired.

Mr. FITHIAN. Thank you, Mr. Chairman.

Chairman STOKES. Gentleman from Pennsylvania, Mr. Edgar.

Mr. EDGAR. Thank you, Mr. Chairman.

Dr. BARGER, it may be redundant, but you were just talking about the issue of probability. As I understand it, there were 2,592 separate correlations made, that is, there were 432 test shots times six segments of tape, is that correct? There were apparently 15 impulses that reached a correlation coefficient of more than 0.5. Is that correct?

Dr. BARGER. Yes.

Mr. EDGAR. Ten impulses, impulse matches of the Dallas Police Department tape, and the reconstructed tape are asserted for shot No. 3, is that not correct?

Dr. BARGER. I think you are referring to Professor Weiss and Mr. Aschkenasy, and in their analytical extension they achieved 10 matches. Is that what you are referring to?

Mr. EDGAR. Yes, on shot No. 3.

Dr. BARGER. Yes; in that, in their echo pattern which contained 12 echoes, they found that 10 of them matched with 10 of the 14 impulses that they observed in the Dallas tape.

Mr. EDGAR. That was different from your 15?

Dr. BARGER. Well, if we are—is what I said true? I mean, are you referring to their analysis?

Mr. EDGAR. I am referring to their 10 impulses that they found on the Dallas police tape.

Dr. BARGER. Yes. Well—

Mr. EDGAR [continuing]. Which matched up for the shot No. 3.

Dr. BARGER. Yes; that is correct. Now, when I described our correlations at the last testimony, we had different numbers than that. The number 15 is not related to that issue. The number 15 is the total number of correlation coefficients that exceeded the threshold; the number 10 is the total number of impulses that happen to match with echoes within one match, which, as I recall, they calculated for that a correlation coefficient of 0.77.

Mr. EDGAR. OK. We are at least agreed there are a lot of numbers floating around, and one of the numbers that are so difficult to zero in on is how someone takes a look at all of that data and all of those impulses and all of those shot patterns, and all of those pieces of tape and all of those squiggly lines and say, aha, it is clear to me that there is a 95-percent probability that this is a third shot. And I guess I am just not clear, and I would hope you could clarify for me what it is that you base that 95 percent on. What is the calculation or formula that it is based upon?

Dr. BARGER. All right. In the case of Professor Weiss and Mr. Aschkenasy's match, which I suspect is the one you are referring to, because the number 15—well, I am not sure. Is that it?

Mr. EDGAR. Let us just deal with the 95-percent probability.

Dr. BARGER. On the third shot?

Mr. EDGAR. That a third shot occurred from the grassy knoll. That is all. Throw away all of the other things.

Dr. BARGER. OK.

Mr. EDGAR. And you just focus in on the 95 percent. You came before us in September and said that possibility was 50-50. We gave your data to Dr. Weiss and his team, and they came back and said, now it is 95-percent chance. As I understand your testimony, you are agreeing with their analysis, that it is now 95 percent?

Dr. BARGER. Yes.

Mr. EDGAR. Probable.

Dr. BARGER. For the third.

Mr. EDGAR. The question I am asking basically is for the third shot, what is the bases, the calculation or formula upon which you reached the 95-percent number?

Dr. BARGER. OK. That question I understand and I will endeavor to answer it.

I used the hypergeometric probability function to calculate the probability that as many matches as he achieved could have occurred by chance, and on any one try. Then I observed that in his search for the correct location of the motorcycle that would be so precise as to give him a plus or minus $1/1,000$ of a second error on each, he would have to look across the entire width of the street, which was 40 feet, and 9 feet on either side of the microphone No. 4, where our test had indicated he was, the motorcycle was, closest to at that time.

I made the judgment that when he moved his mathematical point, and mathematically extended with his echo calculations every 2 feet, he would get an independent pattern. In other words, the echoes would slide out of the bins that they might otherwise have been in, given that the bins were only twenty-one one-thousandths of a second wide. Therefore, I determined that he had the possibility of generating 180 independent patterns by his process. And so I took the probability that he could have achieved a match

on one, times the number of independent bins he would in principle have had to search in order to cover the area of uncertainty, and I got a value of 5.6 hundredths or approximately 5 percent, and so my estimate in that way was, if a person sat down with a bunch of noise spikes and was calculating new noise spikes by the procedure he used, he could, about 5 times in 100, by chance, find a match to that precision.

Chairman STOKES. Time of the gentleman has expired.

Mr. EDGAR. Mr. Chairman, I ask for 2 additional minutes.

Chairman STOKES. Without objection, the gentleman is recognized 2 additional minutes.

Mr. EDGAR. I think I understand a little bit better how you perceived that probability, and I guess it begs the second question, and that is the question of whether or not we should go back to Dealey Plaza and put up 100 sniper's nests shooting at a specific target and test out your probability of 95 percent, and if I understand what you are saying right, we would only have less than a 5-percent chance of duplicating the echo patterns that were found emanating from the grassy knoll. Is that correct?

Dr. BARGER. Well, if you shot from the wrong places, if you shot from the right places, I would assume 95 times in 100 you would get the same result.

Mr. EDGAR. You are saying if we went back to the—if we went back to the spot that Dr. Weiss says the shot took place—

Dr. BARGER. Yes.

Mr. EDGAR [continuing]. And reenacted that shot today—

Dr. BARGER. Yes.

Mr. EDGAR [continuing]. We have a 95-percent chance of getting the same echo patterns?

Dr. BARGER. Yes.

Mr. EDGAR. You indicated that this process is a little bit like fingerprinting, and the FBI and other law enforcement agencies that use fingerprinting in the process have a statistically determined base that is based on millions of uses. You have, I think, induced the analogy; it should not be further induced that you have looked at many different physical locations similar to Dealey Plaza and attempted to match up similar fingerprints. Is that correct?

Dr. BARGER. That is correct. In fact, what you are suggesting would be called a statistical validation of the test, and one could conduct this kind of test in other environments that were nominally similar and determine from a repeated set of those tests what the probabilities, in fact, are, and that would be called a statistical validation of the test, and that is a wonderful thing to do.

Mr. EDGAR. One final comment, and then I will quit. You were here this morning when I raised the question about the temperatures and the degrees, and we talked at length with Dr. Weiss over lunch about the value of looking at the temperature and the temperature as a factor of determining the echo patterns, and the validity of the data that was presented. I believe that that is one area that could be explored further in the future by some other body, taking a look at your tests in a careful and considered way. Would you agree that temperature and validity factors of factors like temperature and wind might be something that ought to be

looked at in evaluating the work you have done and the work Dr. Weiss has done?

Dr. BARGER. Yes; it is worth differentiating. The test that I did was insensitive both to the uncertainties that we had in temperature and wind. Professor Weiss and Mr. Aschkenasy were getting close to the point where uncertainties in temperature would cause them to, you know, make an error. I do not believe they were there yet, but they were getting close.

They were also getting close to the point where wind could have been a problem. In other words, if the Mach number of the wind had achieved a value of .05, wind projected along the line of sight of the sound, then that could have become a problem for them. I doubt very much if it did, because that would represent a projection along the line of sound of about a 40-mile-an-hour wind, and the wind was not, I do not believe, blowing in that direction that day, so it would have taken about an 80-mile-an-hour wind to have a projection in the direction of the sound screen that would have been significant. But in my test, where I have such a large acceptance window, you know, I was really insensitive to those things. I believe they were getting close to where temperature and wind have an effect. I do not believe that it was a detrimental effect.

Mr. EDGAR. Thank you. I yield back my time.

Chairman STOKES. Time of the gentleman has expired.

Any other members of the committee seeking further recognition?

Dr. Barger, at the conclusion of a witness' testimony before our committee, the witness is entitled to 5 minutes to either explain or amplify or in any way further comment upon his testimony before our committee. I would extend to you at this time 5 minutes for that purpose.

Dr. BARGER. Thank you. I found that this particular problem that was brought to us by your committee was a most difficult problem, and it was, it involved the activities of a good deal of people at BBN who brought to this their own special expertise. I could not have come close to knowing enough about all of these meteorological, acoustical, radial, motorcycle, reflections, recording, computing, everything that was reported in that report before, and, therefore, I asked others to do it. And since I have the 5 minutes, I would like to acknowledge the work of the colleagues on my research team at our laboratory in Cambridge. And they are Dr. Jared J. Wolf, Dr. Daniel N. Kalikow, Dr. Theodore L. Rhyne, Mr. Scott Robinson, Mr. Leo A. Sledjeski, Ms. Nancy C. McMahon, Mr. Joseph L. Coloruotolo, Mr. Edward C. Schmidt.

I would also like to acknowledge the moral support and the financial support given to me by the division director, Dr. Frank Jackson, and also the help given to me by Dr. Richard Bolt.

Finally, I would like to, I believe, it is important to acknowledge that there is a fundamental principle of some importance that we have been dealing with in this hearing. Professor Blakey conceived the strategy to focus on the scientific evaluation of hard evidence as opposed to recapitulation of eyewitness testimony. And your committee implemented that strategy when it contracted with Bolt, Beranek and Newman, and other research laboratories to conduct these studies.

I believe that our findings demonstrate the wisdom of Professor Blakey's strategy, and, furthermore, that they illustrate a potentially useful way to apply scientific procedures in forensic proceedings.

Thank you.

Chairman STOKES. Thank you very much, Dr. Barger, and I know you spent a great deal of time on this project, and a great deal of time with both the staff and committee, and we appreciate very much your testimony here today.

The Chair recognizes Professor Blakey.

**FINAL COMMENTS BY PROF. G. ROBERT BLAKEY, CHIEF
COUNSEL AND STAFF DIRECTOR**

Mr. BLAKEY. Thank you, Mr. Chairman.

Mr. Chairman, it may be appropriate at this time to review for the committee and those who are following our proceedings the results of the committee's various scientific projects, making an effort to relate them to the acoustics results, and seeing what light, taken together, they shed on the events in Dealey Plaza on November 22, 1963.

According to the acoustical analysis conducted by the committee, four shots, over a total period of 7.91 seconds, were fired at the Presidential limousine. The first, second and fourth came from the depository; the third came from the grassy knoll. In evaluating the acoustics project, it is relevant to ask to what degree its results are consistent with data obtained in other scientific analyses. Similarly, other scientific disciplines may be evaluated comparing them with the acoustics results.

Following the Warren Commission's analysis that found only three shots, one of which missed, it had been generally assumed that the final shot fired at President Kennedy was the one that is vividly depicted at Zapruder frame 313, although the Commission itself acknowledged that the last shot might have missed. Using frame 312—when the bullet would actually have struck the President—as the point of reference, it can be determined that the four shots would have been heard by the limousine occupants at Zapruder frames 166, 196, 296, and 312.

A review of the Zapruder film indicates that a shot fired in the vicinity of frame 166 did not strike any limousine occupants, so it must have missed. The committee's photographic panel, while unable specifically to conclude that a shot was fired at this point, noted that Governor Connally's hand moved from left to right at a rate of 540° per second during frames 162 through 164 and 166 through 167, followed by a more gradual shift of his torso to the right. The panel concluded these movements may have been a reaction to a severe external stimulus. The panel considered these actions to be particularly significant because they were consistent with the Governor's Warren Commission testimony that he had turned in response to having heard the first shot and was struck almost immediately afterward. It is also consistent, of course, with the Governor's testimony before this committee and with the testimony of eyewitnesses.

Some of those statements were incorporated in the record this morning. The relationship between the panel's observations con-